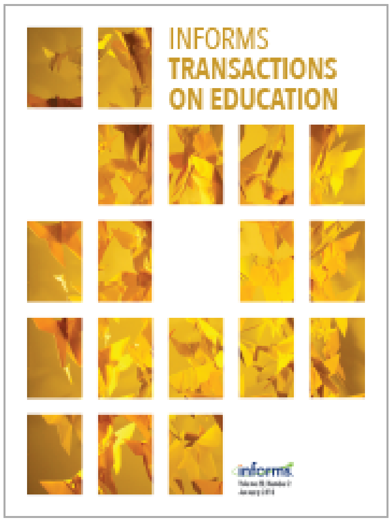

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## Case

# Production Scheduling at Falcon Die Casting

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Falcon Die Casting Company (FDC) is an automotive parts manufacturer based in Ohio. FDC recently patented an innovative method of high volume die casting using traditional die casting machines. This patent was instrumental in FDC receiving a long term contract from a major automobile manufacturer for the bulk of its requirements for five key die cast items used in most of its automobiles.

The customer provides FDC with an indication of the possible demand for the next 12 weeks with the understanding that demand beyond Week 2 is tentative and subject to change depending on auto sales during the preceding weeks. Table 1 shows the projected demand for the next 12 weeks.

FDC can produce the parts on five die casting machines, each of which is capable of producing a subset of the parts as indicated in Table 2. For example, Part 1 can be produced only on Machines 1 and 2. Similarly, Machine 4 can only produce Parts 2 and 3. While FDC has the design capacity needed to meet the customer's long term demand for the five parts, the effective capacity at present is just enough to satisfy the demand because a significant percentage of items produced are not at a quality level demanded by the customer. This situation is likely to remain the same for the immediate future until the defect levels are gradually brought under control through experience and continuous improvement. FDC's industrial engineers developed yield factors, which are quite accurate in predicting the proportion of parts that meet the customer quality specifications. Table 2 provides the production rates for the five parts on the five machines along with the yield factors. For instance, producing Part 1 on Machine 1 for 3 hours yields 72 ($= 3 \times 40 \times 0.6$) items of Part 1 that meet the specifications and, thus, can be used to fulfill demand. There is no wastage of metal because defective parts can be melted and reused.

Production takes place Monday through Friday with three eight-hour shifts per day, yielding 120 hours

**Table 1** **Projected Demand**

| Week | Part 1 | Part 2 | Part 3 | Part 4 | Part 5 |
|---|---|---|---|---|---|
| 1 | 3,500 | 3,000 | 4,000 | 4,000 | 2,800 |
| 2 | 3,000 | 2,800 | 4,000 | 4,300 | 2,800 |
| 3 | 3,000 | 2,000 | 4,000 | 3,500 | 3,000 |
| 4 | 3,000 | 3,000 | 4,000 | 3,800 | 2,800 |
| 5 | 3,000 | 3,000 | 4,000 | 4,000 | 2,800 |
| 6 | 3,500 | 2,500 | 4,000 | 3,800 | 2,500 |
| 7 | 3,500 | 2,500 | 3,800 | 4,000 | 2,500 |
| 8 | 3,300 | 3,400 | 3,700 | 4,200 | 2,500 |
| 9 | 3,300 | 3,400 | 0 | 4,500 | 3,000 |
| 10 | 3,200 | 3,000 | 0 | 4,500 | 3,000 |
| 11 | 4,500 | 4,000 | 5,000 | 5,000 | 3,800 |
| 12 | 3,000 | 2,800 | 4,000 | 4,300 | 2,800 |

**Table 2** **Production Rates (Units/Hour)**

| | Part 1 | Part 2 | Part 3 | Part 4 | Part 5 |
|---|---|---|---|---|---|
| Machine 1 | 40 | | | 60 | |
| Machine 2 | 35 | 25 | | | |
| Machine 3 | | 30 | | | 45 |
| Machine 4 | | 35 | 50 | | |
| Machine 5 | | | | 60 | 50 |
| Yield (%) | 60 | 55 | 75 | 65 | 60 |

**Table 3** **Part Setup Times (Hours)**

| | Part 1 | Part 2 | Part 3 | Part 4 | Part 5 |
|---|---|---|---|---|---|
| Machine 1 | 8 | | | 8 | |
| Machine 2 | 10 | 8 | | | |
| Machine 3 | | 10 | | | 24 |
| Machine 4 | | 8 | 12 | | |
| Machine 5 | | | | 8 | 20 |

of regular time per week on each machine. Weekends are normally used for preventive maintenance and experimentation to improve the production process but may be used for overtime production when necessary. Thus, the maximum possible overtime production on any machine is 48 hours per week. Based on the current projected demand for the five parts, FDC realized that overtime production over the weekends will be a fact of life until the yields are sufficiently improved. Due to a long standing policy of not keeping any finished goods inventory at the end of a week, weekly production is limited to that week's demand.

Setting up machines to produce various parts takes significant amount of machine time, ranging from 8 to 24 hours as shown in Table 3 and setup times do not depend on the order in which the parts are produced on a machine. Setup and production of a part can span more than one shift without any lost time. However, as a consequence of preventive maintenance and experimentation over the weekends, all machines need to be set up anew each week.

Weekly production planning is typically carried out in a time-consuming trial-and error-process by adjusting the previous week's production plan taking into account changes in the weekly demands, production rates, and setup times. While production planners do their best to avoid unnecessary setups, on many occasions production of a part had to be scheduled on more than one machine in order to meet the customer demand. Additionally, the final schedules often resulted in excessive overtime on some machines while other machines were idle during the regular time production.

Tom Kelley, the production manager, wanted scheduling to be carried out in a systematic manner with some assurance that the final schedule assigns production of parts to machines in an optimal manner. Since production employees are paid time and half for overtime work, Tom is very keen on meeting the demand for the five parts with the least amount of overtime.

Tom is also curious about the impact of the company policy to not carry finished-goods inventory from week to week. He has had discussions with the maintenance supervisor that lead him to believe that it should be possible to perform routine maintenance during weekends without disturbing the machine setups.